

E3/10V

THE
New METHOD
OF
Sign^r DOROTHEO ALIMARI,
PROFESSOR of the
MATHEMATICKS
IN
VENICE,
For Discovering the
LONGITUDE.

HUMBLY PRESENTED

To the Right Honourable the LORDS,
and Others, Appointed by Act of Parliament COM-
MISSIONERS, for Examining and Judging of
Proposals for finding the LONGITUDE.

L O N D O N :

Printed for J. ROBERTS near the *Oxford-Arms* in *Warwick-*
Lane, MDCCXIV.

240 Longitude

THE
NEW METHOD

Harvard College Library
Perry-Chase Fund
December 3, 1951

SIR DOROTHY ALMARA

PROFESSOR of the

MATHEMATICS

IN

NEW YORK

For Discovering the

LONGITUDE

HUMBLY PRESENTED

To the Right Honourable the LORDS
and Members of the HOUSE OF COMMONS
MISSIONERS for Examining and Judging of
Proposals for finding the LONGITUDE

LONDON:

Printed for J. Roberts near the Oxford-arm in Warwick
Lane, MDCCXIV.

T O

The Right Honourable THOMAS Earl of Pembroke and Montgomery.

The Right Reverend Father in God PHILIP Lord Bishop of Hereford.

The Right Reverend Father in God GEORGE Lord Bishop of Bristol.

The Right Honourable THOMAS Lord TREVOR, Lord Chief Justice of the Common-Pleas.

The Admirals of the Red, White and Blue Squadrons.

The First Commissioner of the Admiralty.

The First Commissioner of the Navy.

The First Commissioner of Trade.

The Master of Trinity-House.

The Honourable Sir THOMAS HANMER, Baronet, Speaker of the Honourable House of Commons.

The Honourable General STANHOPE.

The Honourable FRANCIS ROBERTS, Esq;

Sir ISAAC NEWTON, President of the Royal Society.

WILLIAM LOWNDES, Esq;

WILLIAM CLAYTON, Esq;

Mr. JOHN FLAMSTEAD, Astronomer Royal.

Dr. EDMUND HALLEY, Savilian Professor of Geometry.

Mr. JOHN KEILL, Savilian Professor of Astronomy.

Mr. SANDERSON, Lucasian Professor of the Mathematicks.

Mr. ROGER COTES, Plumian Professor of Astronomy.

Commissioners appointed by Act of Parliament for the Discovery of the
L O N G I T U D E.

My LORDS and GENTLEMEN,

UPON the Encouragement of the late Act of Parliament, I presume Humbly to lay before your Honours *A Method of Discovering the Longitude*

DEDICATION.

at Sea with great Exactness. 'Tis the Product of much Study, Time, and Experiment; and what will, I hope, fully Answer the End. The Description here given of the Instrument is so plain, that after this, a good Workman may easily make it. Besides, whenever I have Your Commands, the Instrument made by the Author's own immediate Direction, and what he hath made frequent Trials of, with Success, shall be laid before Your Honours. 'Tis a great Pleasure to Me, thus to lay the Fruits of so long Labours before Persons, upon whose Judgment I can with so much Confidence rely; and upon whose Justice I may depend, with no less Security.

I am,

My LORDS and GENTLEMEN,

Your Honours most Obedient,

*St. James's-Square,
August the 31st,
MDCCXIV.*

Humble Servant,

SEBASTIANO RICCI.



Fundamenta quibus in-
 nixus DOROTHEUS ALI-
 MARI, inter Mathemati-
 cos minimus Longitudinem
 Civitatum, & locorum U-
 niversi terraquei Globi as-
 sequi posse contendit.

Primum,  **F**undamentum con-
 sistit in determi-
 natione Primi a-
 licujus Meridia-
 ni, qui ex omnibus terraquei Globi
 partibus comprehendendi, atque distingui
 possit, quod bucusq; ab alijs aptè fac-
 tum non videtur: Ut hoc eleganter
 fieri queat, non melius Auctor agere
 se posse credidit, quam si ad datum
 aliquem Meridianum ad placitum eli-
 gibilem exactissimæ conderentur Ephe-
 merides Solarium motuum in Lon-
 gitudine, & Declinatione ad Gradus,
 Minuta, atq; Secunda, ut ex eis ad
 quodcumque tempus haberi posset vera
 Solis Longitudo, & Declinatio, ac
 utrius-

DOROTHEUS ALIMARI,
*Professor of the Mathema-
 ticks, proposes to find out
 the Longitude of all Cities,
 and Places of the Terrestrial
 Globe by the following Me-
 thod.*

First,  **S**UCH a Meridian
 must be pitch'd up-
 on as may be di-
 stinguished from all
 other Parts of the Globe, which
 doth not seem to have been hither-
 to conveniently done; and this
 the Author believes cannot be bet-
 ter perform'd, than by making exact
 Ephemerides of the Motion of the
 Sun in its Longitude and Declina-
 tion, as to Degrees, Minutes, and
 Seconds, for any Meridian that shall
 be pitch'd upon, that thereby the
 true Longitude, and Declination of
 the Sun plac'd in its first Meridian,
 and the Diurnal Motion of both may
 at

utriusque motus diurnus, Sole constituto in ipso Meridiano primo. Propterea Ephemerides prædictas condidit Auctor ipse modo supra enunciato ad Meridianum Insulae Ferreae, quem sibi placuit pro Archimeridiano constituere.

Secundum, Auctoris fundamentum ponitur in diligentissima observatione verae altitudinis Solis supra Orizontale planum in gradibus, minutis, atque secundis, quam facere se posse confidit (excepto tamen magnarum Procellarum tempore) non obstante consuetudo navis, & maritimorum fluctuum motu, & agitatione, ope unius Instrumenti simplicis structurae, tenoris ejusmodi.

Habeatur Cylindrus, seu Tubus externa, & interna, constructionis perfectissima crassitie unius unciae circiter, internè vacuus. Hic ex aurichalco, ære, buxo, vel aliâ quavis duriori materiâ construi potest. Ejus verò Longitudo, quantò major fuerit, tantò melior erit, commoda verò creditur si fuerit unciarum sexaginta circiter: in ejusque superficie per Longum diligentissime adnotabuntur unciae singulae.

In superiori, seu verticali parte ipsius Tubi, seu Cylindri ad angulos admissim rectos statuendus est circulus

at any time be obtain'd. And therefore he hath made such Ephemerides, calculated to the Meridian of the Island of Ferro, which he chose for his first Meridian.

Secondly, The Degrees, Minutes, and Seconds of the true Altitude of the Sun, must be very carefully and exactly observ'd; which he is confident [except in very great Storms] may be done, notwithstanding the usual Motion, and Agitation of the Sea, with this plain Instrument, viz.

Get an Hollow Cylinder, or Tube, one Inch thick, exactly made either of Brass, Copper, Box, or of any hard Material, and the longer it is the better; however it is thought, that one of about 60 Inches wou'd be convenient. The Inches ought to be carefully mark'd upon the Outside.

A flat Brass Circle must be plac'd exactly at right Angles on the Top of this Tube. The Diameter of this Circle

culus aereus planus, cujus diameter sit unciarum novem, quorum unam occupabit Cylindri ipsius crassities; residua Diametri ejusdem circuli partes, quae erunt unciarum quatuor, divisa intelligantur in partes 100000, sic ut (iis vicem gnomonis continui praestantibus) gnomonis ipsius Longitudo sinum totum repraesentet: In ipsius autem circuli centro statuendum est foramen aequale foramini ipsius tubi; Immittatur deinde ipsi tubo funis, seu chorda tantae crassitiei, ut foramen ipsum ad unguem impleat, & quantum oportuerit ultra se extendat: ejus Chordae pars, quae fuerit ex parte memorati circuli, tripedali, vel quadrupedali fulcro suspendatur & alligetur; inferiori vero appendatur Globus aereus sacculo inclusus ponderis Librarum 50; erigatur deinde quadrupedale fulcrum, itaque firmiter statuatur, ut instrumentum, cum Globo ipso libero in aere constituatur; fiet enim, ut (premente Globi ipsius pondere Chordam) ille continuo stet Horizonti perpendicularis, & per consequens circulus aereus praedictus sit plano Horizontali parallelus, non obstante aliquo navis motu: Nam licet perpendicularum ipsum ob eundem motum situm mutaret, funis tamen continuo Horizonti perpendicularis haberetur.

Instrumento ipso tali pacto constituto,

Circle must be of 9 Inches, whereof one is taken up by the Thickness of the Tube. The remaining Parts of the Diameter of the Circle, which shall be Four Inches, ought to be suppos'd to be divided into 100000 Parts so that (they serving as a continued Gnomon) the Length of the Gnomon may represent the Radius. A Hole must be made in the Center of the Circle exactly of the same Bigness with that of the Tube. A Line, or Chord, of such a Thickness, as may exactly fill up that Hole must be pass'd through it, and extended as shall be needful. Let that part of the Chord towards the said Circle be suspended upon a Three, or Four Legg'd Frame. Hang on the lower Part a Brass Ball in a Bag of 50 Pounds Weight; then raise up and fix the said Frame so, that the Instrument and Ball hang freely in the Air; the Weight of the Ball pressing the Chord, that Ball shall always be perpendicular to the Horizon; and consequently the said Brass Circle, notwithstanding the Motion of the Ship, Parallel to the Horizontal Plane. For tho' this Perpendicular by such a Motion should alter its Site, the Chord will always remain Perpendicular to the Horizon.

Such an Instrument being made, when

to, incidentibus Solaribus radiis in superiorem Circuli partem, ejusdem umbra in inferiorem projicietur, ejusque minor Longitudo in parte Cylindri Soli obversâ signabitur. Ut autem hæc adamussim haberi queat in partibus, quarum gnomon, ut supra, est 100000, possibilitatem præstabit nobile Trochleæ artificium, quod à nobis hic non describitur, cum apud Professores notæ credatur inventionis. Hoc etiam commodi ex hoc nostro Instrumento accedet, ut quomodocumque ipsum sit Soli obversum, eadem semper unico temporis momento accidet umbræ Longitudo.

Cum Solis altitudo supra Horizontale planum fuerit præcisè graduum 45, ejus umbra erit ad unguem partium 100000, & propterea gnomoni æqualis, unciarum scilicet quatuor: excedente verò Solari Altitudine gradum quadragesimum quintum (licet æquè, & benè usque ad octogesimum Solaris Altitudinis gradum eadem regula inservire posset) nos tamen, ad evitandam umbræ Longitudinem non benè distinctam, præstare putamus in superficie ipsius ærei Globi gnomonem unum, vel plures ad angulos rectos constitutos habere, Longitudinis uncia unius, in Centro circuli, seu circularum, quorum semidiameter gnomonis ipsius Longitudini sit æqualis; ipsorum enim gnomonum modo, quo
supra

when the Rays of the Sun fall on the upper Part of the Circle, the Shadow of it will be cast below; and its lesser Longitude will appear on that Part of the Cylinder which is toward the Sun. A noble Kind of Trochlea, which I do not describe here, because already sufficiently known, will make it possible to take this in the 100000 Parts whereof we have said the Gnomon consists. This Advantage will result from that Instrument, that which way soever it is turn'd to the Sun, you'll see in an Instant the Length of the Shadow.

When the Altitude of the Sun above the Horizontal Plane shall be exactly 45 Degrees, its Shadow shall also be exactly 100000 Parts, and therefore equal to the Gnomon, (*viz.*) of 4 Inches. But if the Sun's Altitude is more than 45 Degrees, (tho' the same Rule may as well hold for the Sun's Altitude even to 80 Degrees) yet because the Length of the Shadow may not be plain, it is thought better to have on the Superficies of the Brass Ball, one, or more Gnomons plac'd at right Angles, of an Inch long, in the Center of the Circle or Circles, whose Semidiameter may be equal to the Length of the Gnomon it self; the Shadow of those Gnomons being measur'd as
above,

suprà, dimensa umbra, eaque quadruplicata tangentem complementi Solaris Altitudinis æquabit; quam ob rem in Tabulis ipsa tangens perquisita dabit præcisam Solis Altitudinem in Gradibus, Minutis, atque Secundis, quo casu superflua Cylindri Longitudo rescari possit.

Solis Altitudine adinventâ, ut suprà, vel alio quocumque pacto, si ejus observatio facta sit in Meridianâ verâ Mundi Lineâ, sitque cognita Poli, vel Æquatoris Altitudo in gradibus, minutis, atque secundis, cum qua haberi potest vera Solis Longitudo in Zodiaco, facili negotio emerget & Solis Declinatio in Gradibus, Minutis, atque Secundis: Verùm si prædicta nota non habeatur, ex Triplici Solis observatione eâdem die factâ, Diagramma, seu similis figura componatur, per quam (ceu in speculo) unico temporis momento patefunt vera Meridiana Linea, Magnetica Declinatio, Latitudo ortiva & occidua Solis, ejusdemque Altitudo Meridiana, Declinatio ab Æquatore, arcus semidiurnus, & semi-nocturnus, horarium tempus à momento observationis ad meridiem, vel ortum, aut occasum Solis in ipso observationis loco, unâ simul cum Æquatoris, atque Poli elevatione: quæ omnia si quis in gradibus, minutis, atque secundis habere gestiât, paucorum
trian-

above, and quadrupl'd, shall equal the Tangent of the Complement of the Altitude of the Sun; and therefore the said Tangent being look'd in proper Tables, shall shew the exact Altitude of the Sun in Degrees, Minutes, and Seconds, in which case the superfluous Length of the Cylinder may be rescinded.

The Sun's Altitude being found in the aforesaid, or any other Method, (provided the Observation be made in the true Meridian Line of the World) and the Altitude of the Pole, or Equator known in Degrees, Minutes, and Seconds, *with which may be had the true Longitude of the Sun in the Zodiack*; the Declination may easily be found in Degrees, Minutes, and Seconds: But if this doth not appear, let a Diagram, or Figure like it, be contriv'd out of the three Observations of the Sun made that Day, whereby, as in a Glass, you may easily discover, in a Moment, the true Meridian Line, the Variation of the Compass, the Latitude of the Sun's Rising and Setting, its Meridian Altitude, Declination from the Æquator; the Semidiurnal and Seminocturnal Arch, the Hour from the Moment of the Observation at the Meridian, Rising, and Setting of the Sun in the Place of the Observation, together with the Elevation of
 B the

*triangulorum ope, & modico temporis
interstitio per regulas ab ipso auctore
traditas assequi valebit.*

*Ex compertis declinatione Solis, &
arcu semidiurno ad tempus observati-
onis, docet auctor Longitudinis veræ
Solis inventionem in Zodiaco, sive de
tempore, quo Sol in Meridiano, sive
in Horizonte Loci observationis repe-
ritur, quâ Collatâ cum eâ, quam Sol
in Archi-meridiano habere comperitur,
resultat illicò inter utramque Solis
Longitudinem differentia, per quam, &
motum diurnum ejusdem (aureâ ju-
vante regulâ) invenitur arcus Æqua-
toris interceptus inter Archi-meridia-
num ipsum, & Meridianum Loci ob-
servationis, vel inter Archi-meridi-
anum ipsum & circulum declinationis
Solis in Horizonte ortivo, vel occiduo,
aut ubilibet positi, quibus respectivè
casibus opportuna enunciatur regulæ
veræ Loci observationis Longitudinis
nanciscendæ.*

*Quod ope Solaris Longitudinis fi-
ri auctor demonstravit, id pariter per
ascensiones ejusdem rectas, & brevius
(ali-*

the Æquator, and the Pole; and if
any desire to have all this in Degrees,
Minutes, and Seconds, it may be
attain'd by the help of some few
Triangles, and in a short Time by
proper Rules prescrib'd by the Au-
thor.

From the Declination of the Sun,
and Semidiurnal Arch being found
at the time of Observation, the Au-
thor shews the true Longitude of the
Sun in the Zodiack; or the Time,
wherein the Sun is found in the Me-
ridian, or in the Horizon of the Place
of Observation, which being com-
par'd with that, which the Sun is
found to have in the first Meridian,
a difference results from these two
Longitudes of the Sun; whereby, and
by its Diurnal Motion, you find by the
Golden Rule the Arch of the Æqua-
tor intercepted between the first Me-
ridian, and the Meridian of the Place
of Observation; or between the first
Meridian it self, and the Circle of the
Declination of the Rising and Setting
of the Sun in the Horizon, or else-
where, in all which Cases there are
proper Rules to discover the Longi-
tude of the Place, where the Obser-
vation is made.

What the Author hath demonstra-
ted may be done by the help of the
Sun's Longitude, he shews by proper
Rules

(Caliquando) per observatam tantum declinationem ipsius Solis fieri posse per opportuna præcepta ostendit.

Ne verò imperitiores Nautæ Longitudinem locorum assequi cogantur per quotidianas observationes, ut supra faciendas, innuit Auctor modum instrumenti organici portatilis ad horologij normam componendi, in cujus facie præter consuetas horas, minuta, atque secunda, licet intueri circulum divisum in partes 360, per quem Æquator representatur; cujus instrumenti beneficio ad quodcumque temporis momentum deprehendi potest verus locus Solis in Æquatore, & proinde ejus vera distantia ab Archimeridiano; Ita enim indicis ipsius instrumenti temperatus est cursus, ut quo tempore Sol in Archimeridiano comperitur, index ipse ad Meridianum Horologij præcisè deveniat; hinc fit, ut si quavis horâ observetur distantia indicis ipsius à Meridiano ejusdem, illicò resultet, & distantia Solis Æquatoria à Meridiano primo, ex cujus deinde notitiâ facili negotio Longitudinis veræ loci ab auctore docetur inquisitio.

Quod si per Navis agitationem, aeris alterationem, aut aliter instrumentum ipsum variationem, seu alterationem aliquam subire videatur, docetur quomodo per novam observationem ad pristinum Locum restitui queat.
Denique

Rules, that it may also be done by the right Ascensions, and sometimes in a shorter Way by the Declination of the Sun.

But that unskilful Seamen may not be oblig'd to find out the Longitude by the daily Observations before mention'd, the Author proposes a portable Instrument, in the nature of a Clock, upon whose Dial, besides the Hours, Minutes, and Seconds, there is to be a Circle divided into 360 Parts, representing the Æquator; by which Instrument you may, at any Time, find out in what part of the Æquator the Sun is, and consequently the true Distance from the first Meridian; the Motion of this Instrument is so contriv'd, that at the Time the Sun is in the first Meridian, the Index exactly points to the Meridian of the Clock: Hence it follows, that at whatsoever Hour you observe the Distance of the Index from the Meridian it self, you'll have the Æquatorial Distance of the Sun from the first Meridian; from which the Author shews, that the Longitude of the Place may be easily discover'd.

That, if that Instrument be put out of Order by the Motion of the Ship, the alteration of the Air, or otherwise, he teaches a Method how to set it right again.

Denique ad prædictorum omnium elucidationem brevis quidem, sed laboriosissimus ab auctore compositus est Tractatus, in quo omnia per Mathematicas demonstrationes, exempla, & opportunos Trigonometriae, calculos enucleantur. His additæ sunt Tabulæ complures ad levandum eorum laborem qui in Trigonometricis calculis expediendis non admodum versati, facili tamen negotio voti compotes fieri gestiunt.

In tanto negotio non credit Auctor certio rem ducem inveniri posse ipso Sole, qui constanti gressu Aequatorum iter quotidie absolvit.

In fine, in order to explain all this, the Author hath compos'd a short and elaborate Treatise, wherein he proves his Assertions by Mathematical Demonstrations, Examples, and Trigonometrical Calculations; to which some Tables are added, for the Ease of those who are not very well skill'd in Trigonometrical Calculations, and whereby however they may easily obtain what they desire.

The Author doth believe, that in so weighty a Matter, he cannot follow a truer Guide than the Sun, which every Day by its constant Course runs round the Globe.



My LORDS and GENTLEMEN,

SINCE I presumed to present to Your Honours The Method of Sign^r ALIMARI for Discovering the LONGITUDE; I have received from Him some other Papers upon the same Subject, which I here Humbly submit to Your Honours Judgment; and am with the utmost Respect,

My LORDS and GENTLEMEN,

Your Honours most Obedient,

St. James's Square,
Septem. the 11th,
MDCCXIV.

Humble Servant,

SEBASTIANO RICCI

SEBASTIANO RICCI

Humble Servant,

Your Honour's most Obedient,

My Lords and Gentlemen,

the warmest Respect,

submit to Your Honour's Judgment; and am with

upon the same Subject, which I have Humbly

have received from Him some other Papers

for Discovering the LONGITUDE;

I Honour The Method of Sign ALMANAC

INCE I presented to present to Your

My Lords and Gentlemen,

*Inveniendæ Longitudinis Civitatum, & locorum
Universi Terraquei Globi vera, & indubitata
Methodus DOROTHEI ALIMARI.*

QUoniam sermo noster ad eos est directus, qui in Cosmographiâ, Astronomiâ, alijsque Mathematicis sunt exercitati, non immorabimur in exponendis rerum terminis, definitionibus, atque principiis, sed ex abrupto rei ipsius substantiam aggrediemur.

Primo loco in promptu sunt habendæ Ephemerides Diurni motûs Solis, & Lunæ in Longitudine exaratæ in gradibus minutis, & secundis ad Meridianum Primum, vel aliam quemcumque, quem pro Primo haberi cupimus (opus semper alicujus diligentissimi Astronomi, & cum observationibus conveniens). Habeantur secundo loco diligentissimæ Tabulæ Ascensionum Rectarum plurium Stellarum Fixarum, insigniorum, & magis notarum in diversis Cœli partibus positarum, & hæ pariter expressæ in gradibus, minutis, atque secundis ad tempus observationis faciendæ; item Tabulæ Ascensionum Rectarum Solis ad singulos Eclipticæ gradus pariter in gradibus, minutis, atque secundis: Sit & optimum Horologium exprimens tempus discessûs & reditûs alicujus Stellæ fixæ ab uno ad eundem Meridianum in Horis 24, & harum quamlibet in minutis sexaginta, & horum quodlibet in secundis pariter sexaginta: Sint & in promptu Instrumenta propria ad iter Navis quàm certissimè fieri possit dimetiendum; Habeatur demum & Pyxis Nautica optimâ cuspide munita: quomodo autem hæc omnia parentur, infrâ dicetur.

Hiscæ paratis (antequam Sol, vel Luna ad Meridianum loci Observationis deveniat) inveniantur eorum Ascensiones Rectæ (de more) in gradibus, minutis, atque secundis ad ipsorum Luminarium loca in ipsis Ephemeridibus expressa in Meridie antecedente, & in Meridie subsequente Observationem (servatâ semper in Lunâ latitudine, quam in Meridiano Ephemeridum obtinuerit;) cumque hæ in promptu fuerint,

fuerint, observetur Sol, vel Luna in Meridiano Mundi, & eodem tem-
 poris momento aptetur Index Horologii ad ipsius Meridianum, & decur-
 rere permittatur (observatio Solis interdiu, Lunæ Noctū fieri debet :)
 expectetur dein adventus alicujus Stellæ fixæ cognitæ ad Meridianum
 eundem, & momento eodem observetur tempus elapsum inter transi-
 tum Solis, vel Lunæ, & Stellæ per eundem Meridianum, converta-
 turque (de more) in Gradus, Minuta, atque Secunda Æquatoris, erit-
 que Arcus iste differentia inter Ascensionem Rectam Solis, vel Lunæ,
 & Stellæ in ipso Observationis Momento ; propterea si subducatur ab
 Ascensione Rectâ Stellæ, nota remanebit Ascensio Recta Solis, vel
 Lunæ, pro ratione scilicet eorum alterutrius in Meridiano Observati.
 Hic duplici ratione uti possumus ad inveniendam loci Longitudinem,
 vel scilicet, (adinventæ Ascensionis Rectæ operâ) inquirendo loca Solis,
 vel Lunæ (respectivè) in Eclipticâ, aut Zodiaco, eaque conferendo
 cum eorum locis in Ephemeridibus expressis, ut eorum resultet diffe-
 rentia, quâ mediante, & mediante eorum Planetarum motu diurno
 in Longitudine, optata loci Longitudo habeatur ; vel adinventam
 Ascensionem Rectam Solis vel Lunæ comparando (respectivè semper)
 cum eâ, quam in Meridiano Ephemeridum retinere comperti fuerint,
 ut earum resultet differentia. His peractis, (subductâ Ascensione
 Rectâ, quam Sol, vel Luna habuerit in Meridie antecedente Obser-
 vationem ab eâ, quam habuerit in Meridie subsequente) habebitur
 motus Diurnus eorum respectivæ Ascensionis Rectæ, tumque fiat, ut
 motus Diurnus antedictus ad integrum Æquatoris Circulum, ita adin-
 venta superius differentia ad Arcum Æquatoris interceptum inter
 Meridianum Primum, seu Ephemeridum, & Meridianum loci
 Observationis : Tunc advertendum est, an loca Luminarium ob-
 servata sive in Longitudine, sive in Ascensione Rectâ sint mi-
 nora, æqualia, vel majora existentibus, sive resultantibus in E-
 phemeridibus Meridiei antecedentis ; nam si minora sint, signum
 est, locum Observationis Orientaliorem esse Meridiano Primo seu E-
 phemeridum, quo casu Arcus Æquatoris supra compertus, est vera
 loci Observationis Longitudo : Si loca prædicta sint æqualia, signum
 est, Observationem factam fuisse in ipso Meridiano Primo, sive Ephe-
 meridum, quo casu nulla erit observati loci Longitudo : Ubi verò
 sunt majora, signum est, locum Observationis esse Occidentaliorem
 Meridiano Primo, quo casu Arcus Æquatoris supra compertus subdu-
 cendus

cendus venit à gradibus 360, quodque remanet est vera loci Observationis Longitudo numerata à Meridiano Primo versus Ortum.

Hic pariter advertendum venit, quòd si quis in Observatione ipsâ faciendâ non usus sit Ephemeridibus conditis ad Meridianum Primum, sed ad alium quemcumque, notam habere debet saltem per Chartas Geographicas bene correctas loci Ephemeridum Longitudinem à Meridiano Primo sibi bene placito, ut adinventam loci Longitudinem per ejusdem Additionem, vel Subductionem opportunè corrigere queat.

Ut autem prædicta omnia exemplis à nobis illustrentur, duo dabimus exempla; alterum scilicet Observationis factæ Venetiis in Sole sub die tertiâ mensis Aprilis Anni 1708, in quâ faciendâ usi sumus Ephemeridibus Solarium motuum à nobis conditis ab Anno 1707, ad Annum 1713 ad Kal. Januarij, ad Meridianum Insulæ Ferreæ, quem pro Primo posuimus, utentes ipsius Solis Longitudine, & Ascensionibus Rectis Stellarum fixarum à nobis pariter Calculo exaratis ad Kal. Januarij Anni 1710; alterum verò exemplum dabimus in Lunâ, quam facimus Observatam fuisse Bisantijs sub Die 28 Martij Anni 1640, pro qua Observatione faciendâ, cum in promptu non essent Ephemerides Diurni motûs Lunæ exaratae ad Meridianum Primum, placuit nobis uti Ephemeridibus conditis ad tempus prædictum ab Andrea Argolo ad Meridianum Romæ, prout & Tabulis Stellarum fixarum ab ipso datis ad Kal. Januarij Anni 1640, in quo exemplo, loco Longitudinis ipsius Lunæ, inservient nobis ejusdem Ascensiones Rectæ, pro quibus exemplis elucidandis ita nos expediemus.

Sit igitur primo loco facta Solis Observatio Venetiis sub Die 3. Aprilis Anni 1708; & quia intentum nostrum assequi intendimus non per Solis Ascensiones Rectas, sed per ejusdem loca in Eclipticâ (neglectâ Ascensionum Rectarum Solis inquisitione in Meridie antecedente, & in Meridie subsequente Observationem) ad ulteriora procedemus per loca ejusdem in Eclipticâ.

Cum igitur sub Die 3. Aprilis 1708, observatus sit Sol in Meridiano Venetiarum, & (Horologio modo congruo disposito) post Horas 9 : 4' : 24" : 4" in Meridiano eodem observatus sit Regulus, seu Cor Leonis; cujus Ascensio Recta ex nostris Tabulis ad idem tempus fuit grad. 148 : 45' : 26", conversis propterea Horis 9 : 4' : 24" : 4" temporis Horarij observati inter transitum Solis, & Stellæ per eundem Meridianum in Gradus, Minuta, atque secunda Equatoris 136 : 6' : 1", fr

G. NOV. 1708. 1709. 1710. 1711. 1712. 1713. 1714. 1715. 1716. 1717. 1718. 1719. 1720. 1721. 1722. 1723. 1724. 1725. 1726. 1727. 1728. 1729. 1730. 1731. 1732. 1733. 1734. 1735. 1736. 1737. 1738. 1739. 1740. 1741. 1742. 1743. 1744. 1745. 1746. 1747. 1748. 1749. 1750. 1751. 1752. 1753. 1754. 1755. 1756. 1757. 1758. 1759. 1760. 1761. 1762. 1763. 1764. 1765. 1766. 1767. 1768. 1769. 1770. 1771. 1772. 1773. 1774. 1775. 1776. 1777. 1778. 1779. 1780. 1781. 1782. 1783. 1784. 1785. 1786. 1787. 1788. 1789. 1790. 1791. 1792. 1793. 1794. 1795. 1796. 1797. 1798. 1799. 1800.

subducantur hi ab Ascensione Rectâ Reguli gr. 148 : 45' : 26", remanebit Ascensio Rectâ Solis gr. 12 : 39' : 26", quibus in Tabulâ Ascensionum Rectarum Solis respondere comperiuntur gr. 13 : 45' : 44" signi Arietis. Hi collati cum Longitudine, quam Sol habuit ipsa Die in Meridiano Primo, scilicet Insulæ Ferreæ, quæ fuit gr. 13 : 51' : 28", apparet illico differentia Longitudinum gr. 0 : 5' : 44"; motus vero Diurnus ejusdem Die ex Ephemeridibus ipsis inventus est gr. 0 : 58' : 57", seu Secundorum 3537, quare si gr. 0 : 58' : 57", seu Secunda 3537 dant totum Equatoris Circulum gr. 360, seu Minuta 21600 motus proportionalis gr. 0 : 5' : 44", seu sec. 344 dabit pro quæsita Longitudine Venetiarum minuta 2100, hoc est gr. 35, q. e. d.; Fuit enim locus Solis in Eclipticâ tempore Observationis minor loco Solis in eadem Eclipticâ in Meridie ipsius Meridiani Primi.

Mox exemplum daturi de Lunâ (cum nos ponamus Ephemerides non habere exprimentes motum Lunæ diurnum in ipso Meridiano Primo) autemur (ad placitum) Ephemeridibus Andreae Argoli exaratis ad Meridianum Romæ pro invenienda Longitudine Constantinopolitanae Urbis, in quâ nos effingimus inter Meridiem Diei 27, & Diei 28 Martii Anni 1641 observatam fuisse Lunam in Meridiano, & post Horas 3 : 27' : 18" in eodem Meridiano apparuisse insignem Stellam Azimech, seu spicam Virginis (inspectis propterea ante ipsam Observationem locis Lunæ in Meridie antecedente, & in Meridie subsequente in Zodiaco) sub Diei 27 Meridie compertam in gr. 13 : 10' signi Leonis cum Latitudine Meridionali gr. 4 : 58', quibus respondet Ascensio Rectâ gr. 134 : 10', & in Meridie Diei 28 in ipso Meridiano Romæ visa rest obtinuisse gr. 25 : 46', signi Leonis cum Latitudine Meridionali gr. 4 : 56', & Ascensione Rectâ gr. 146 : 18', factâ conversione Horarii Temporis supra observati Horarum 3 : 27' : 18" in Gradus, & Minuta Equatoris 51 : 49' : 22", hisque subductis ab Ascensione Rectâ spicæ Virginis, quæ (ex eodem Argolo) ad Annum 1640 fuit gr. 197 : 33', remanent pro Ascensione Rectâ Lunæ gr. 145 : 43' : 37" $\frac{1}{3}$, qui collati cum Ascensione Rectâ Lunæ in Meridie Diei 28 Martii prædicti, erit eorum differentia gr. 0 : 34' : 22" $\frac{1}{3}$, motus vero Diurnus Ascensionis, qui habetur ex subtractione Ascensionis Rectæ Diei 27 ab Ascensione Rectâ Diei 28, cum inventus sit gr. 12 : 8', seu Minut. 728, si propterea fiat, ut motus Diurnus Ascensionis Min. 728 ad integrum Equatoris Circulum gr. 360, seu Minut. 21600, ita differentia supra inventa gr. 0 : 34' : 22" $\frac{1}{3}$ ad quartum, adcrit

aderit quarto loco Longitudo Constantinopolitanae Urbis quaesita Minutorum 1019 $\frac{1}{2}$, hoc est gr. 16 : 59' : 40" à Meridiano Romae numerata versus Ortum ; cui, si addantur Gradus Longitudinis Romae à Meridiano Insulae Ferreae ex Mappis Sansonianis comperti in summa gr. 35, aderit integra Constantinopolis Longitudo à Meridiano Primo, scilicet Insulae Ferreae graduum 51 : 59' : 40", q. e. d.

Quod de Ephemeridibus Andreae Argoli nos fecimus, fieri respectivè potest de aliis quibuscunque ad alium quemlibet Meridianum ordinatis tam pro Sole, quam pro Lunâ, modò illae sint exactissimae, & Observationibus consonantes.

Haec, si adamussim servantur, cum Mathematicas habeant in promptu demonstrationes, Experimentis pariter confirmari poterunt ; verum, quia huic Praxi, quam nos expeditam esse intendimus, plurimae obesse videntur difficultates, eas nos resolvere conabimur.

Difficultates nonnullae in Longitudinis inveniendae Praxi, ut supra, quae sint, & quomodo resolvantur.

PLurima in hac Praxi obesse videntur, quae operationem ipsam non modicis difficultatibus involutam ostendunt. Prima difficultas consistit in Horologio Aequinoctiali inveniendò, quod adamussim discessum, & reditum Stellae ab uno ad eundem Meridianum dimetiatur in partes aequales, seu Horas 24, quarum quaelibet divisa intelligatur in portiunculas Sexaginta, & harum quaelibet in alias Sexaginta portiunculas, & in ejusdem Horologii congruo usu. Secunda difficultas consistit in determinando Meridiano, in quo Observationes sunt faciendae. Tertia, motus Navis de loco ad locum cum Meridiani mutatione non tam de facili Praxim ipsam admittens. Quarta difficultas consistit in cognitione Stellarum fixarum, & comparatione exactissimae earum Ascensionis Rectae. Quinto, & postremo loco difficultas in inveniendâ Itinerariâ distantia, seu itinere Navis cum differentiâ Longitudinis inter duo loca, in quibus faciendae sunt Observationes ; quibus Objectionibus respondere eas dilaturi non dubitabimus. Primae Objectioni circa Horologium exactissimum comparandum, quod adamussim metiatur tempus discessus unius Stellae ab uno Meridiano, & reditus ad eundem in partes aequales, seu Horas 24, quarum quaelibet divisa sit in partes 60, & harum quaelibet aliis sexaginta constet

particulis, respondemus, reverà horarium tempus computari debere, habito respectu ad motum Stellarum fixarum, non verò Solis, vel alterius Planetæ, qui aliquanto tardius ad eundem perveniunt Meridianum, quàm Stellæ fixæ pro ratione eorum motûs in ordine signorum: Attamen, si tale nobis Horologium deficeret, alio quocumque uti nobis licebit (modò id æqualibus temporibus constanter æqualia metiatur spatia, alioquin illud omnino rejicietur:) ante tamen, quàm eo utamur, experimentum capiemus, observando scilicet discessum, & reditum unius Stellæ ab eodem ad eundem Meridianum, quot scilicet Horis, Minutis, atque secundis Horologii nostri adamussim expleatur in diversâ Aëris, & motûs Navis constitutione, & hoc ipso Horologio utemur in Observatione temporis Horarii, ut suprâ, quod (aureâ juvante regulâ) corrigemus. Exempli gratiâ, si observatus sit Periodus Stellæ in datâ aliquâ Aëris Constitutione confici intra Horas 23 : 30', horarium verò tempus sit h. 5 : 15', sic operabimur. Si h. 23 : 30' Horologii nostri dant Horas Æquinoctiales, hoc est Sydereas 24, quid dabunt h. 5 : 15' Horologii nostri? & dabunt tempus Horarium æquatum Horarum 5 : 21' : 42", seu gr. 79 : 32' : 48" subducendos ab Ascensione Rectâ Stellæ in simili datâ Aëris Constitutione. Idem operabere (respectivè referendo,) si tempus discessûs, & reditûs Stellæ excesserit h. 24 Horologii nostri, & oppositæ difficultati provisum remanebit: Hoc tamen utiq; servandum venit, ut Horologium ipsum æqualibus temporibus constantissimè æqualia metiatur spatia, & tanto melius judicatur, si per plures Dies cursum suum absolvat eodem cursûs, tenore licet sufficiat illud per Horas duodecim tantùm sine sensibili alteratione decurrere; advertendum autem, ut utamur eodem in simili Aëris constitutione, respectivè semper referendo.

Quoad secundam difficultatem, quo scilicet in Meridiano faciendæ sint Observationes Luminarium, & fixarum, pleno ore fatemur, optimum fore, si illæ fiant in Meridiano Vero, scilicet Mundi; in eo enim terminantur Ascensiones eorum Rectæ, non verò in Meridiano Magnetico: Nos tamen pro certo habemus, quòd validè possint ipsæ Observationes fieri etiam in Meridiano Magnetico, modò Magnetica Declinatio sensibilem non experiatur de loco ad locum variationem; neque enim alia intercedere potest differentia, quàm in eo, quòd portiuncula Ascensionis Rectæ debita gradibus magneticæ Declinationis nonnihil citius à Stellâ mensuretur, quàm à Luminaribus, ob eorum Diurnam retardationem in perveniendo ad eundem Meridianum; alioquin certum est

est (positâ æquali Magneticâ declinatione) horarium tempus à Meridiano verò ad Meridianum verum æquale semper esse horario à Meridiano magnetico ad Meridianum magneticum: quare sine errore notabili in Magnetico non secus, ac in Meridiano vero observationes fieri valent, horariumque tempus reditûs Stellæ fixæ ad Meridianum magneticum subductum ab Ascensione Rectâ Stellæ, Ascensionem Rectam veram ipsius Luminaris in residuo gignere, modò & Luminare & Stella in eodem magnetico observentur Meridiano; ad tollendas tamen omnes scrupulositates ope Ortivarum, vel Occiduarum Latitudinum, bonum erit Nautas diebus singulis Magneticam observare declinationem, ut præcisè Meridianus ipse, in quo faciendæ sunt observationes, habeatur: & hoc circa secundam difficultatem.

Tertiæ Difficultati, quomodo scilicet agendum sit, si inter duas faciendas Observationes, Luminaris scilicet, & Stellæ, Navis iter facere cogatur, responderetur, aut Navis ab Austro ad Boream, vel à Borea ad Austrum procedit, & his casibus, cum Navis non mutet Meridianum, nihil ultra prædicta venit faciendum; procedente verò Navi ad Ortum, observandum, quàm per quartam, seu Rhombum procedat, & per Instrumenta propria ad hunc usum explorandum venit iter per Navim inter utramque observationem emensum, & differentia Longitudinis elicienda in gradibus, minutis, atque secundis Æquatoris, illaque venit addenda tempori horario inter utramque observationem decurso, & aderit horarium tempus æquatum ab Ascensione Rectâ Stellæ subducendum; procedente verò Navi ad Occasum, differentia Longitudinis, ut suprà inventa subducitur horario tempori, ut suprà, ut illud æquatum habeatur ab Ascensione Rectâ Stellæ subducendum.

Placet hic nobis exemplum præbere in observatione per nos factâ Venetijs, ut suprà à nobis expositâ, supponamusque Navim nostram post observatum Solem in Meridiano processisse Ortum versus per Rhombum, seu quartam, quam Transmontanæ Nationes appellant *sudest*, nos verò Itali vocamus *Ostro Sirocco*, & intrâ Horarium tempus emensum inter observationem Solis, & Stellæ absolvisse Milliaria Italica quinquaginta, ad inveniendam differentiam Longitudinis inter hæc data duo Loca observationum, fiat primò, ut sinus totus ad Milliarialia quinquaginta, ut suprà emensa per Navim, ita sinus gr. 22. 30'. hoc est Anguli Meridiani cum quartâ *Ostro sirocco*, ad Milliarialia Italica decem, quibus recessit Sol à Meridiano Venetiarum versus Ortum; his dein in Parallelo, ad quem Navis devenit (de more operando) respondere

respondere comperiuntur minuta quatuordecim *Æquatoris*, quæ (nâvi procedente versùs Ortum) addita temporì horario, ut suprà observato, horarum 9. 11'. 45". 4", hoc est gr. 136. 31'. 1". constituent horarium tempus æquatum graduum 136. 45'. 1". subducendum ab Ascensione Rectâ Reguli, quæ ad tempus observationis ex nostris Tabulis fuit gr. 148. 45'. 26", & remanet Ascensio Recta Solis gr. 12. 0'. 25", cum quibus operabimur, ut suprà factum est, singula singulis respectivè referendo.

Quartæ difficultati, quæ duas continet partes, hoc est, quomodò imperitiores Nautæ Stellæ fixas, earum nomina, & situm cognoscere queant, & quomodò earum Ascensiones Rectas ipsimet adamussim comprehendere valeant, ita respondemus.

Quoad Primam, indiget Nauta noster Cœlesti Globo quantum fieri poterit maximo, in quo Asterismi, & imagines omnes, quæ habentur tam in Zodiaco, quàm extrâ, sive ad Boream, sive ad Austrum sint diligentissimè delineati, atque dispositi, cum Stellis fixis in eorum quolibet contentis, prout revera in Firmamento conspiciuntur, earumque (saltem præcipuarum) nominibus, atque Magnitudine distinctis : huic Globo Nautica Pyxis sit adnexa, cujus Meridiana Linea vel sit in Plano Meridiani ipsius Globi, vel illi Parallela.

Hunc Globum Nauta noster statuet in Plano aliquo Horizonti Naturali Parallelo, & in loco aperto (potiùs solido, & immobili, quàm mutanti, & mobili) cum elevatione Poli congruâ loco observationis, & in Plano Meridiani Mundi Loci observationis, noctu dein quâlibet horâ, exempli gratiâ, horâ tertiâ noctis, accedens Globo suo, ut suprà disposito, circumgyrabit illum donec Locus in Eclipticâ, in quo Sol die illâ reperièbatur, Horizontem Occiduum præcisè infideat, tunc observans gradum *Æquatoris* ex ipsâ Occidentali parte se secante, cum Horizonte eodem Globum suum gyrabit, quousque sub Horizontem descendant alij gradus 45 *Æquatoris*, (totidem enim debentur horis tribus noctis) & habebit Globum suum constitutum juxta positum Cœli, & Mundi eâdem horâ : observatis dein Asterismis in Meridiano ipso, vel prope in Globo suo descriptis cum Stellarum Figuris, & nominibus in ipso Globo notatis, è regione ipsis in Firmamento respondente observabit Stellæ fixas, quarum nomina, situm dextrum, vel sinistrum, antecedentem, subsequenter, vel medium, aut in ipsâ Asterismi parte positum distinctè ex ipsius Globi inspectione cognoscet ; inde circum-

cumgyrans Globum suum (prout horæ creverint) eadem Methodo succedentes Meridiano Stellas diligentissimè observans plures per Noctes, & diversis Anni temporibus, uberem Stellarum ipsarum fixarum notitiam sibi comparabit. Quâ autem ratione Nauta noster, etsi minus in Astronomiâ versatus, Stellarum fixarum Ascensiones Rectas exactissimè habere queat (etsi in Triangulis Sphæricis supputandis, ut cæteri Professores facere consueverunt, non admodum sit edoctus) ita se expediet.

Primo loco habeat in promptu Ephemerides alicujus boni Astronomi, & in Meridie ejus diei, in quâ Ascensionem Rectam Solis habere voluerit, observet motum Solis Diurnum in Longitudine : habeat dein cognitam differentiam Longitudinis inter Meridianum Loci observationis, quam elicere poterit vel ex ipsis Ephemeridibus, (solent enim Ephemeridum conditores eam in Tabulis Civitatum exarare) vel ex Chartis Geographicis benè correctis : hisce comparatis, per Regulam Auream fiat, ut totus Æquatoris Circulus gr. 360, seu min. 21600 ad motum Solis Diurnum in Longitudine habitum, ut supra ex ipsis Ephemeridibus, ita differentia Longitudinis supra comperta ad partem proportionalem dicti motûs subducendam à Loco Solis in meridie Ephemeridum (si Locus observationis fuerit Orientalior) addendam, si fuerit Occidentalior, Meridiano Ephemeridum, & consurget vera Solis Longitudo in gradibus, minutis, atque secundis, cum quâ in Tabulâ Ascensionum Rectarum Solis (de more) ejus Ascensio Recta comparari poterit in gradibus, minutis, atque secundis ; in hoc autem operator debet esse sollicitus, ut hæc Solis Ascensio Recta, prout & sequentes Stellarum fixarum observationes, fiat in Meridiano vero Mundi, & in solo stabili, non autem in Navi, ne minimus aliquis error in observatione interveniat : Observato Sole in Meridiano, illicò Horologio suo Æquinoctiali, velut supra diximus, opportunè disposito, attendet adventum alicujus Stellæ fixæ ad eundem Meridianum, & illicò observato diligentissimè tempore horario decurso, illud convertet in gradus, minuta, & secunda Æquatoris, & addet inventæ Ascensionis Rectæ Solis, & ex aggregato consurget Ascensio Recta Stellæ quæsitæ.

Habitâ unius Stellæ fixæ Ascensione Rectâ, facili negotio aliarum omnium Ascensiones Rectæ comparari poterunt ; si enim Stella cognita minorem in Zodiaco Longitudinem obtinuerit incognitâ, observabitur in Meridiano Stella cognita cum tempore horario decurso usque ad adventum Stellæ incognitæ ad eundem Meridianum, hocque addito
Ascensioni

Ascensioni Rectæ Stellæ, confurgit Ascensio Rectæ Stellæ incognitæ : ubi verò Stella cognita majorem habuerit in Zodiaco longitudinem incognitâ, subducetur horarium tempus ab Ascensione Rectâ Stellæ cognitæ, & aderit Ascensio Rectæ Stellæ incognitæ quæſita.

Sit, exempli gratiâ, cognita Ascensio Rectæ Aldebaran, quæ ex nostris Tabulis ad Kal. Januarii 1710 est gr. 64. 51'. 25", quæraturque Ascensio Rectæ Capitis Medusæ minorem in Zodiaco Longitudinem habentis; factâ primùm observatione Medusæ in Meridiano vero, inde temporis horarij decursi, quod ponitur fuisse hor. 1. 33'. 48". quibus respondent gradus Æquatoris 23. 27'. 11". si hi subducantur ab Ascensione Rectâ Aldebaran gr. 64. 51'. 25" aderit Ascensio Rectæ Capitis Medusæ graduum 41. 24'. 25".

Quæro indè Ascensionem Rectam Sirij majorem in Zodiaco Longitudinem habentis, quàm Aldebaran : hanc primò observo in Meridiano, indè tempus horarium decursum, quod fuit hor. 2. 14'. 12". seu gr. Æquatoris 33. 33, hos addo Ascensioni Rectæ Aldebaran gr. 64. 51'. 25". & confurgit Ascensio Rectæ Sirii gr 98. 24'. 25". Eodem modo operabimur in cæteris, & facili negotio voti compotes erimus; sufficiet autem harum Stellarum magis notarum, & variis in Globi partibus dispositarum Ascensiones rectas comparatas habere.

Quinta difficultas, quæ versatur in inveniendâ itinerariâ distantîâ, emerſa ex motu Navis de prioris observationis loco ad locum secundæ, etsi in rigore Geometrico plures contineat difficultates in ejus Praxi, attamen eam etiam Nautæ minus periti propè præter cognoscere pluribus modis, & Instrumentis, ac etiam per Solis motum, & positum rectificare didicerunt, adeo ut superfluum ducamus ulterius instruere Mineram; agitur enim de tritâ Praxi, navigantibus omnibus passim notâ.

Demum Nautam Lectorem hujus compendioli nostri monitum volumus, ut diligentissimis, atque correctissimis utatur Ephemeridibus, & Tabulis; atque in observandis tum Luminaribus, tum Stellis fixis præcisè in Meridiano, tum in horario tempore computando, aliisque supputationibus ineundis maximâ utendum esse diligentîâ, non neglectis secundis, multò minus & minutis; unius enim secundi neglectio in observationibus faciendis supputationes ipsius Longitudinis considerabiliter augere, vel minuere valet, quæ discretus, & prudens Nauta per se comprehendere, & corrigere valebit.